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Orofacial manifestations in outpatients with anorexia nervosa and bulimia nervosa focusing on the vomiting behavior

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Abstract

Objective This case-control study aims to evaluate the oral health status and orofacial problems in a group of outpatients with eating disorders (ED)—either anorexia nervosa (AN) or bulimia nervosa (BN)—further focusing on the influence of vomit.

Materials and methods Fifty-five women outpatients with AN or BN diagnosis were invited to participate, of which 33 agreed. ED outpatients and matched controls were submitted to a questionnaire and clinical oral examination.

Results Multivariate analysis identified a significantly higher incidence of teeth-related complications (i.e., tooth decay, dental erosion, and self-reported dentin hypersensitivity), periodontal disease, salivary alterations (i.e., hyposalivation and xerostomia), and oral mucosa-related complications in ED outpatients. Dental erosion, self-reported dentin hypersensitivity, hyposalivation, xerostomia, and angular cheilitis were found to be highly correlated with the vomiting behavior.

Conclusions ED outpatients were found to present a higher incidence of oral-related complications and an inferior oral health status, compared to gender- and age-matched controls. Alterations verified within outpatients were acknowledged to be quite similar to those previously reported within inpatients, in both of nature and severity, thus sustaining that the cranio-maxillofacial region is significantly affected by ED, even in the early/milder forms of the condition, as expectedly verified within outpatients.

Keywords Anorexia nervosa · Bulimia nervosa · Eating disorders · Vomit · Oral manifestations

Eating disorders (ED) are psychiatric diseases, with a multifactorial etiology, characterized by alterations of the eating behavior and associated with significant psychosocial impairment, systemic complications, and increased suicide risk [1–3].

The fifth edition of Diagnostic and Statistical Manual (DSM-V) comprises anorexia nervosa (AN) and bulimia nervosa (BN) as avoidant/restrictive eating disorders [4]. Anorexia nervosa is characterized by a body mass index (BMI) below 17.5Kg/m^2 and a patient's sustained weight loss [4]. Additionally, anorexia nervosa is subdivided into restrictive type, in which the weight loss is accomplish through food intake reduction, prolonged fasting, and excessive physical activity; or purgative type—characterized by the use of laxatives, diuretics and/or appetizer's suppressors, or vomit induction [4]. Patients with bulimia nervosa present a BMI above 17.5Kg/m^2 and recurrent episodes of binge eating. Similar to AN, it can be subdivided into restrictive or purgative types [4].

Previous studies provided some information on ED-associated oral complications, but with conflicting results regarding its prevalence, reversibility, and association with the ED subtypes and exacerbation periods [5]. Tooth decay, dentin hypersensitivity, dental abrasion, dental attrition, sialoadenosis, and hyposalivation are some of the parameters with conflicting results, notwithstanding the verified tendency for ED patients to present an inferior oral health status compared to age- and gender-matched controls [6–9]. The majority of previously published data on ED-related oral manifestations has been gathered from inpatients, considering the clinical diagnosis of AN or BN, but discarding associated symptoms that may be relevant for oral health status, such as vomiting.

Little is known regarding the relevance of the ED subtype and associated conducts, particularly the vomiting behavior

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within the verified oral manifestations, given the acknowledged influence on the disequilibrium of the oral microenvironment [10]. Whether inpatients normally present a more severe ED status and associated complications—including those of the oral/maxillofacial domain [11]—from a clinical point of view, it is desirable to identify early oral complications associated with ED, in order to expedite referral, evaluation, diagnostic, and treatment, not only with respect to psychological and somatic complications, but also in regard to the verified oral manifestations [12]. This is expected to be more easily accomplished within ED outpatients' assessment, who expectedly present a less severe condition and associated complications. As well, little is known regarding the relevance of the ED subtype and associated conducts, particularly the relevance of the vomiting behavior within the verified oral manifestations, given its putative influence on the disequilibrium of the oral microenvironment [10].

In accordance, this study aims to investigate the oral health status and orofacial problems in an outpatients group with AN and BN, further focusing on the influence of vomiting. Attained data was compared to a matching age and gender control group.

Methods

The present study was approved by the Ethics Committee of *Centro Hospitalar de São João* (CHSJ), Porto, Portugal, and informed consent were obtained from all participants.

Participants

From January to April 2015, 55 women diagnosed with AN or BN, according to DSM-V, undergoing psychotherapy treatment at CHSJ, were invited to participate in the study. The study group included women outpatients, aged between 18 and 50 years, with legal and cognitive autonomy to understand and sign the informed consent. Men and women inpatients and outpatients with other ED diagnosis, or with diagnosed AN or BN associated with other medical conditions or previously admitted as inpatients, were excluded from the study. Patients under pharmacologic treatment were further excluded. Individuals presenting less than six teeth in the oral cavity were excluded from the study.

The control group included healthy women, aged between 18 and 50 years, without previous history or risk of suffering of ED and with legal and cognitive autonomy to understand and sign the informed consent. Individuals under pharmacologic treatment and less than six teeth in the oral cavity were further excluded.

Twenty-two patients (40%) declined to participate for considering themselves not to have any oral problem ($n = 3$) or because they did not have the time and/or interest ($n = 19$). There were no significant differences regarding age and ED diagnosis between the non-participants and the study group.

Thirty-three patients (60%) agreed to participate and constituted the eating disorders group (EDG). Patients were further subcategorized according to the ED diagnosis of AN and BN. In order to further address the effects of vomiting within the oral health status, patients from the EDG were subcategorized into a vomiting group (VG) and a non-vomiting group (NVG). A criterion was designed to subdivide patients, determined by the product of the duration of the vomit habit in years (minimum ≥ 0.5 years) and its daily frequency (minimum ≥ 2 per day). Patients with a final result ≥ 1 were considered to present a vomiting behavior [13, 14], which led to their enrollment into the VG. The remaining patients, who did not present a vomiting behavior, were enrolled into the NVG, including those who used laxatives. The application of this criterion did not exclude any patient with a history of vomiting habit.

The control group (CG) contained 33 volunteers recruited from ordinary recall patients of CHSJ, being examined during the same period.

Procedures

The Eating Disorder Examination Questionnaire (EDE-Q), a 28-item questionnaire commonly used to perform the clinical diagnosis of ED was applied to controls in order to identify individuals with a high risk of presenting an ED-like behavior. The individual score was calculated based on four subscales: restriction, concern about food, concern about body shape, and concern about body weight. All participants presented an overall score below 2.12, the threshold establish for the global score, and below the specific thresholds of 1.49, 1.37, 2.63, and 2.12, respectively, for restraint, eating concern, weight concern, and shape concern subscales [15].

Groups answered an individual questionnaire that aimed to detect and evaluate possible factors affecting oral health and included questions addressing sociodemographic factors and general and oral health status. This questionnaire was completed at the examination room, prior to the clinical oral examination, performed by a single investigator (ML) and executed in an ordinary medical examination room, using mobile dental research materials and a mobile light unit.

The visual dental examination was performed in all present teeth, including third molars.

Tooth decay evaluation was conducted by visual and probe inspection. The clinically identified lesions were noted, and the decayed-missing-filled tooth (DMFT) and decayed-missing-filled surfaces (DMFS) indexes were calculated according to the World Health Organization (WHO) standards [16].

The clinical diagnosis of dental erosion was made from the observation of characteristic deviations from the original tooth

morphology. Each tooth surface was scored based on a severity scale of 0 (without lesion), 1 (lesion limited to enamel), 2 (lesion affecting dentin), 3 (lesion affecting dental pulp), and 4 (missing or excluded; considering absent teeth, those with extensive decay, filled, repaired with crown or veneers, and presenting abrasion or attrition lesions) [16]. Each tooth was assigned with the code of the surface presenting the most severe lesion.

Evaluation of dentin hypersensitivity was based on patients' self-report of hypersensitivity to cold, sweet, or acidic stimuli.

The periodontal status was assessed by the index teeth, based on the periodontal evaluation through probing of the buccal surface of the first and second maxillary molars, maxillary right central incisor and mandibular left central incisor, and the lingual surface of the first and second mandibular molars. Subjects with gingival recession or periodontal probing depth superior to 3 mm were considered to have periodontitis [17]. Participants presenting visual signs of generalized gingival inflammation, with bleeding and pain after probing, were considered to have gingivitis [17].

Xerostomia was assessed based on patient's complaints of dry mouth and difficulties in performing oral functions [18, 19]. The modified Schirmer's test (MST), performed with sterile paper strips (Schirmer Tear Strips®, ContaCare, Gujarat, India), was used to evaluate the non-stimulated salivary flux (NSSF). Subjects with NSSF ≤ 25 mm, following 3 min of collection, were considered to have hyposalivation [19].

The oral mucosa visual examination intended to detect generalized atrophy, candidiasis, and soft palate lesions. Individuals were also asked about burning mouth feeling. Other alterations, such as dental abrasion, dental attrition, exfoliative cheilitis, fissured tongue, and lichen planus, were clinically identified and characterized.

Statistical analysis

The statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 24.0, Armonk, NY, USA).

The Levene's test and *t* test determined and compared the DMFT and DMFS indexes and hyposalivation between groups, with a 95% confidence level.

The Pearson's chi-squared test (X^2), applied to qualitative variables, meant to determine differences between groups. The level of significance was set at 5% ($p \leq 0.05$).

Results

The main characteristics of the assessed EDG (including segmentation into AN group (ANG), BN group (BNG), VG, and NVG) and CG, regarding age and BMI, are presented in Table 1.

The oral health status of patients and controls was assessed through a questionnaire and direct intra-oral and extra-oral clinical observation. Attained data is presented in Tables 2, 3, 4, and 5, further including the comparative assessment of the formed subgroups based on the vomiting criterion (VG and NVG versus CG). Briefly, 16 patients (48.5%) presented a vomiting behavior, of which 10 were diagnosed with AN and 6 with BN. Eleven of the BN patients used laxatives, instead of inducing vomit, and were included in the NVG, according to the designed criteria.

Regarding the assessment of teeth-related alterations (Table 2) within EDG, significantly higher values of DMFT, DMFS, tooth decay, dental erosion, and self-reported hypersensitivity were verified compared to controls. Dental erosion was further found to present a strong correlation with the vomiting behavior, as significantly higher levels were identified within the VG group—ten patients exhibited lesions affecting dentin (code 2), and one patient exhibited lesions limited to enamel (code 1). No significant differences were identified between the NVG and CG concerning this parameter. Self-reported dentin hypersensitivity and active decay parameters were found to be significantly higher for both VG and NVG, as compared to controls.

In regard to periodontal-related parameters (Table 3), no significant differences were found between groups regarding gingivitis, despite that periodontitis was found to be significantly more common among ED patients—18 cases of periodontitis and 2 cases of gingivitis, regardless of the vomit subcategorization. Only two controls suffered from localized periodontitis, limited to the mandibular central incisors.

Table 1 Characterization of the study population concerning age (years) and BMI (Kg/m^2)

	Age (years)			BMI (Kg/m^2)		
	n	M	SD	*n*	M	SD
CG	33	23.24	3.33	33	21.33	1.69
EDG	33	28.21	10.11	33	17.49	3.07
ANG	18	28.83	11.03	18	15.28	1.58
BNG	15	27.47	9.21	15	20.16	2.14
VG	16	29.25	10.38	16	17.76	2.96
NVG	17	27.24	10.07	17	17.26	3.24
Total	66	25.73	7.875	66	19.41	3.21

95% confidence level

BMI body mass index, *CG* control group, *EDG* eating disorders group, *ANG* anorexia nervosa group, *BNG* bulimia nervosa group, *VG* vomiting group, *NVG* non-vomiting group, *n* number of participants, *M* mean, *SD* standard deviation

Table 2 Characterization of the study population concerning dental structure alterations—tooth decay (DMFS, DMFT, active decay), dental erosion, hypersensitivity, dental abrasion, and dental attrition

	EDG		VG		NVG		CG		EDG[1] /CG		VG/CG		NVG/CG		VG/NVG	
	M	SD	M	SD	M	SD	M	SD	*p*	φ	*p*	φ	*p*	φ	*p*	φ
DMFS	23.72	31.841	22.87	28.648	24.47	35.283	5.55	6.114	0.02*	NA	0.002*	NA	0.004*	NA	0.89	NA
DMFT	8.78	7.006	8.27	5.934	9.24	7.989	4.12	3.990	0.02*	NA	0.006*	NA	0.004*	NA	0.70	NA
Active decay	0.78	0.420	0.80	0.414	0.76	0.437	0.27	0.452	< 0.001*	0.509	< 0.001*	0.493	< 0.001*	0.470	0.81	0.043
Dental erosion	0.69	0.931	1.33	0.900	0.12	0.485	NR	NR	< 0.001*	0.483	< 0.001*	0.809	0.16	0.199	< 0.001*	0.695
SRDH	0.72	0.457	0.93	0.258	0.53	0.514	0.18	0.392	< 0.001*	0.540	< 0.001*	0.707	0.01*	0.359	0.01*	0.448
Dental abrasion	0.06	0.03	0.07	0.258	0.06	0.243	NR	NR	0.15	0.181	0.14	0.216	0.16	0.199	0.93	0.016
Dental attrition	0.246	0.177	0.07	0.258	NR	NR	NR	NR	0.31	0.127	0.14	0.216	NR	NR	0.28	0.191

95% confidence level

M mean, *SD* standard deviation, *NA* not applied in Levenes' *t* test, *NR* no cases registered, *p* level of significance, φ phi coefficient, *statistical significance, *CG* control group, *EDG* eating disorders group, *VG* vomiting group, *NVG* non-vomiting group, *DMFS* decayed-missing-filled tooth, *DMFS* decayed-missing-filled surfaces, *SRDH* self-reported dentin hypersensitivity[1]; 32 participants

Regarding salivary parameters (Table 4), xerostomia and hyposalivation presented a strong relation with ED, fact further sustained by the increased self-reported difficulties during oral function within the EDG. A similar trend was verified through data analysis of both VG and NVG.

Regarding the assessment of soft tissue lesions (Table 5), angular cheilitis and burning mouth feeling were found to be significantly more common in EDG, being the former significantly higher in VG. The presence of exfoliative cheilitis, fissured tongue, and lichen planus did not differ significantly between groups. In addition, no cases of actinic cheilitis, oral candidiasis, or soft palate lesions were identified in either group.

Discussion

The present study aimed to investigate the oral status of an ED outpatient population, further focusing the effect of the vomiting behavior on the development of oral complications. Whether more severe complications are conceivably more frequent in ED inpatients, outpatients' evaluation expectedly allows the identification of earlier clinical signs, further permitting prompt reference, assessment, and intervention. Our study was conducted on a small sample of women outpatients, attending psychotherapy treatment. This should be further taken into account when establishing comparisons between the presented data and other studies' results, broadly conducted in ED inpatients.

The test group was formed by 33 ED patients, diagnosed with AN ($n = 18$) and BN ($n = 15$). A high frequency of migration between AN and BN is reported, as substantiated by the conjoining etiologic mechanisms described for ED establishment and development [20]. Patients were clustered, and data from the attained EDG was compared to a gender- and age-matched CG. As we aimed to investigate the effect of the vomiting behavior on the oral health status and function, a criterion was developed by the investigation team, based on

Table 3 Characterization of the study population concerning periodontal status—periodontitis, gingivitis, and periodontal disease

	EDG		VG		NVG		CG		EDG[1]/CG		VG/CG		NVG/CG		VG/NVG	
	M	SD	M	SD	M	SD	M	SD	*p*	φ	*p*	φ	*p*	φ	*P*	φ
Periodontitis	0.60	0.498	0.64	0.497	0.56	0.512	0.06	0.242	< 0.001*	0.579	< 0.001*	0.629	< 0.001*	0.564	0.65	0.082
Gingivitis	0.29	0.726	0.33	0.816	0.25	0.707	NR	NR	0.39	0.127	0.40	− 0.138	0.57	− 0.092	0.83	0.059
Periodontal disease	30.94	173.785	63.13	249.567	0.65	0.606	0.06	0.242	< 0.001*	0.596	< 0.001*	0.649	< 0.001*	0.585	0.65	0.081

95% confidence level

M mean, *SD* standard deviation, *NR* no cases registered, *p* level of significance, φ phi coefficient, *statistical significance, *CG* control group, *EDG* eating disorders group, *VG* vomiting group, *NVG* non-vomiting group[1]; 32 participants

Table 4 Characterization of the study population concerning salivary parameters alterations—salivary glands hypertrophy (sialoadenosis), self-evaluation of salivary production (xerostomia and difficulties in oral function), and salivary flow rate (MST and hyposalivation)

	EDG		VG		NVG		CG		EDG/CG		VG/CG		NVG/CG		VG/NVG	
	M	SD	M	SD	M	SD	M	SD	*p*	*φ*	*p*	*φ*	*p*	*φ*	*p*	*φ*
Sialoadenosis	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Xerostomia	0.58	0.502	0.69	0.479	0.47	0.514	0.03	0.174	< 0.001*	0.93	< 0.001*	0.717	< 0.001*	0.591	0.21	0.219
DDOF	0.39	0.496	0.56	0.512	0.24	0.437	NR	NR	< 0.001*	0.495	< 0.001*	0.681	0.004*	0.411	0.06	0.335
MST	24.00	9.966	21.00	9.230	26.82	10.064	32.97	4.727	< 0.001*	NA	< 0.001*	NA	0.005*	NA	0.09	NA
Hyposalivation	0.55	0.506	0.75	0.447	0.35	0.493	0.03	0.174	< 0.001*	0.569	< 0.001*	0.764	0.002*	0.440	0.02*	0.399

95% confidence level

M mean, *SD* standard deviation, *NA* not applied in Levenes' *t* test, *NR* no cases registered, *p* level of significance, *φ* phi coefficient, *statistical significance, *CG* control group, *EDG* eating disorders group, *VG* vomiting group, *NVG* non-vomiting group, *DDOF* difficulties during oral function, *MST* modified Schirmer's test

literature report, so the EDG group was further subdivided into VG and NVG [13, 14].

Distinct parameters characterizing dental caries, dental erosion, and self-reported dentin hypersensitivity were assessed. In regard to dental caries, patients presented significantly increased DMFT, DMFS, and tooth decay scores compared to controls, independently of the vomiting subcategorization. Previous studies have reported conflicting results regarding caries scores in ED patients. Some authors found no significant differences [21], others reported significantly lower DMFS values [22], and some others found significantly higher scores [6]. In accordance with the data attained in our study, a trend for increased DMFS score was verified in a recent meta-analysis for ED patients, independently of the clinical diagnosis and vomiting behavior [7]. The variety of results may elapse from a number of factors, including small sample sizes verified in some studies, adopted methodologies, and the multifactorial etiology of tooth decay [9].

Dental erosion is characterized by a progressive and irreversible loss of the mineralized tooth structure, induced by a non-bacterial chemical process [23, 24]. Smooth silky-shining glazed dental surfaces characterize the early signs of this pathology. Progressive lesions are often flat or shallow concavities, coronal to enamel-cementum junction. More advanced stages present changes in the original tooth morphology, with cupping or grooving on the occlusal/incisal surfaces [25]. In the present study, EDG and VG presented significantly higher levels of dental erosion, evidencing a high correlation of ED, with vomit, in agreement with previous studies [9, 23, 26]. Vomit is responsible for the chemical attack and consequent tooth demineralization, particularly on the surfaces left unprotected by the tongue and soft tissues [27], so a characteristic pattern has been reported, embracing the palatal surfaces of the maxillary teeth and occlusal surfaces of mandibular molars [23], as in agreement with the verified data.

Table 5 Characterization of the study population concerning perioral (actinic cheilitis, exfoliative cheilitis, angular cheilitis) and oral mucosa alterations (oral candidiasis, soft palate lesions, stomatodynia, fissured tongue, and lichen planus)

	EDG		VG		NVG		CG		EDG/CG		VG/CG		NVG/CG		VG/NVG	
	M	SD	M	SD	M	SD	M	SD	*p*	*φ*	*p*	*φ*	*p*	*φ*	*p*	*φ*
Actinic cheilitis	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Oral candidiasis	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Soft palate lesions	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Exfoliative cheilitis	0.09	0.292	NR	NR	0.18	0.393	NR	NR	0.08	0.218	NR	NR	0.013*	0.352	0.08	− 0.307
Angular cheilitis	0.15	0.364	0.25	0.447	0.06	0.243	NR	NR	0.02*	0.286	0.003*	0.428	0.16	0.199	0.13	0.266
Stomatodynia	0.12	0.331	0.13	0.342	0.12	0.332	NR	NR	0.04*	0.254	0.038*	0.296	0.05*	0.284	0.95	0.011
Fissured tongue	0.03	0.174	0.06	0.250	NR	NR	0.03	0.174	1.00	< 0.0005	0.59	0.076	0.47	− 0.103	0.30	0.182
Lichen planus	0.03	0.174	NR	NR	0.06	0.243	NR	NR	0.31	0.124	NR	NR	0.16	0.199	0.33	− 0.0171

95% confidence level

M mean, *SD*: standard deviation, *NR* no cases registered, *p* level of significance, *φ* phi coefficient, *statistical significance, *CG* control group, *EDG* eating disorders group, *VG* vomiting group, *NVG* non-vomiting group

Tooth wear erosion may be a predisposing factor for dentin hypersensitivity [28]. A significantly higher level of self-reported hypersensitivity was verified for the EDG, with a strong correlation with the vomiting habit. We found a correlation between the severity of the erosive lesions and dentine hypersensitivity, reinforcing the vomiting-related acidic challenge as an etiologic factor [29, 30]. Despite this, data also shows a significantly higher level of self-reported dentin hypersensitivity in the NVG, suggesting the involvement of other ED-related factors in its etiology. Care should be taken when interpreting these results once dentin hypersensitivity evaluation was exclusively based on patients' reports.

Compared to controls, EDG, VG, and NVG patients reported higher levels of xerostomia, hyposalivation, and self-reported difficulties within the oral function. Changes within the salivary biochemical profile and flow rates of ED patients have been previously described [6, 7, 31, 32]. The frequent self-induced vomit, the misuse of laxatives, diuretics, and/or appetite suppressors, associated with excessive physical activity, may induce a sustained dehydration and exert a negative effect on the volume of produced and secreted saliva [33, 34]. These alterations may be further aggravated by the common use of antidepressants for ED treatment, with some presenting a known xerostomizing effect [35]. The association between a reduced salivary flow rate and a lower buffering capacity, leading to a lower salivary pH within the oral microenvironment, may further increase the risk of tooth demineralization and decay, as previously discussed [21, 36, 37].

Concerning the effects on the periodontal tissues, no significant differences were found regarding gingivitis, despite the increased incidence of periodontitis in EDG, regardless the vomit subcategorization. Previous studies outputted conflicting data regarding gingivitis indexes, as significantly reduced [5], similar [38, 39], or higher scores [21, 36] were reported for ED patients. The attained variability on oral hygiene levels [40–43] may justify, at least in part, the verified discrepancies. Some studies suggested that ED patients presented a reduced interest in oral health and hygiene practices due to the underlying depressive condition [41, 42]. Contrariwise, some patients may show a high level of oral hygiene and a more compulsive oral hygiene practice [43]. Within the present study, a higher tooth brushing frequency was found for the EDG, without significant differences regarding its duration. Patients reported adequate oral hygiene practices following vomit, namely the rinse with water or acid-neutralizing solution.

Other factors may justify the verified differences concerning periodontal parameters. A significantly higher number of smokers was identified on EDG, in accordance with previous reports, sustaining the higher prevalence of smoking in ED-affected individuals [44]. Tobacco use is correlated with a consistent suppressive effect of the inflammatory clinical signs [45, 46], thus contributing to the underestimation of gingivitis. The net sum of tobacco-induced alterations on the periodontal tissues converges to a local tissue breakdown, further contributing to periodontitis establishment and development [46, 47]. Despite this, smoking habits were not addressed in the majority of studies addressing periodontal health in ED patients.

Apart from tobacco, other known factors may have an impact on periodontal status. Nutritional imbalances may induce hematological disorders, particularly anemia, thrombocytopenia, leukopenia, and neutropenia, all common ED-related alterations and known contributing factors for periodontitis [48, 49]. Vitamins C and D avitaminosis, a frequent ED outcome [26, 50], may interfere with collagen synthesis, involved in the periodontal turnover, and further exhibit an immunomodulatory activity, known to play a role on periodontitis establishment and development [51]. The deficient intake of other micronutrients (e.g., iron, calcium, zinc, selenium, magnesium, and copper) [52] can further contribute to the altered status of periodontal health [53].

No cases of actinic cheilitis, oral candidiasis, or soft palate lesions were identified, in either EDG or CG, and no significant differences were found regarding fissured tongue, lichen planus, and exfoliative cheilitis. Significant higher levels of angular cheilitis were identified in EDG and VG, compared to controls. Given the high prevalence of angular cheilitis with VG, vomit is expected to play a role on the disease onset and development, as local irritation may arise from mechanical trauma associated with the self-induced vomiting and/or the regurgitation of acidic gastric contents [54].

Increased burning mouth sensation, or stomatodynia, was found on EDG, being described as a form of burning/stinging sensation or pain, in the absence of any clinical and/or laboratory abnormalities of the tongue or oral mucosa [55]. It has been previously associated with ED [8] and understood as the expression of psychological discomfort and/or somatoform disturbances, disclosing from the eventual underlying depressive condition [56] or associated with the verified neurological changes [57]. Local factors, such as oral mucosa atrophy—highly related with nutritional deficiencies and vomit—may contribute to the etiology of the diffuse oral burning sensation in ED patients [8].

Within the present study, it was verified that ED patients presented a significantly higher incidence of oral complications and an inferior oral health status, in comparison to gender- and age-matched controls. Some of the attained alterations were highly correlated with the self-induced vomit behavior.

Of most relevance, the verified oral alterations in ED outpatients were very similar to those previously reported in the literature regarding ED inpatients, in terms of diversity and severity, advocating that the stomatognathic system is significantly affected by ED. These findings highpoint the relevance of the support and management of ED patients by oral healthcare professionals, not only for the treatment of the

established complications and prevention/education for oral health but also on the early identification and referral of suspicious conditions.

Accordingly and considering the increased emphasis put on the interdependent relation between physical and psychiatric morbidities, the consideration of an integrated assessment, plan, and management of ED patients, in which oral healthcare professionals are active members of a multidisciplinary team, could contribute to an improved outcome on the management of both ED-related psychological and somatic complications.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval All procedures performed in this study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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